UNIVERSITY OF JAMMU

NOTIFICATION
(18/June/Adp/34)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the revised Syllabi and Courses of Study in the subject of **Chemistry** of **Master Degree Programme** for I to IV Semesters under the **Choice Based Credit System (through regular mode)** in the main Campus for the examinations to be held in the years as per the details given below:-

Subject	Semester	for the examination to be held in the years
Chemistry	Semester-I	December 2018, 2019 and 2020
	Semester-II	May 2019, 2020 and 2021
	Semester-III	December 2019, 2020 and 2021
	Semester-IV	May 2020, 2021 and 2022

The Syllabi of the courses is available on the University website: www.jammuuniversity.in

Sd/-
DEAN ACADEMIC AFFAIRS

No. F. Acd/II/18/5203-5222
Dated: 22-6-2018.

Copy for information and necessary action to:

1. Special Secretary to the Vice Chancellor, University of Jammu for the kind information of the Worthy Vice-Chancellor please
2. Sr. P.A. to the Dean Academic Affairs/ Dean Research Studies
3. Sr. P.A. to the Registrar/Controller of Examinations
4. Dean, Faculty of Science
5. HOD/Convener, Board of Studies in Chemistry
6. All members of the Board of Studies
7. C.A to the Controller of Examinations
8. I/c Director, Computer Centre, University of Jammu
9. Asst. Registrar (Conf. /Exams. PG/ Inf./Pub.)
10. Incharge, University Website for necessary action please.

Assistant Registrar(Academic)

19/6 19/6 19/6/18

POST GRADUATE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF JAMMU, JAMMU

M.SC. CHEMISTRY **(Choice Based Credit System)**				
S.No.	**Course No.**	**Course Category**	**Title**	**Credits**
Semester-I				
1.	PSCHTC101	PSCC	Theories of Bonding and Inorganic Reaction Mechanism	04
2.	PSCHTC102	PSCC	Quantum Chemistry	04
3.	PSCHTC103	PSCC	Organic Reaction Mechanism-I	04
4.	PSCHTC104	PSCC	Principles of Spectroscopy	04
5.	PSCHLC105	PSCC	Laboratory Course: Inorganic Chemistry	03
6.	PSCHLC106	PSCC	Laboratory Course: Physical Chemistry	03
7.	PSCHLC107	PSCC	Laboratory Course: Organic Chemistry	02
Semester-II				
1.	PSCHTC201	PSCC	Group Theroy and Transition Metal Chemistry	04
2.	PSCHTC202	PSCC	Chemical Dynamics, Surface and Electro Chemistry	04
3.	PSCHTC203	PSCC	Organic Reaction Mechanism-II	04
4.	PSCHTC204	PSCC	Applications of Spectroscopy in Organic Chemistry	04
5.	PSCHLC205	PSCC	Laboratory Course: Inorganic Chemistry	03
6.	PSCHLC206	PSCC	Laboratory Course: Physical Chemistry	02
7.	PSCHLC207	PSCC	Laboratory Course: Organic Chemistry	03
Semester-III				
1.	PSCHTC301	PSCC	Photochemistry and Spectroscopy in Inorganic Chemistry	04
2.	PSCHTC302	PSCC	Thermodynamics and Statistical Mechanics	04
3.	PSCHTC303	PSCC	Bio-organic and Medicinal Chemistry	04
4.	PSCHTO304	PSOCC	Environmental Chemistry	04
5.	PSCHLC305	PSCC	Laboratory Course: Inorganic Chemistry	02
6.	PSCHLC306	PSCC	Laboratory Course: Physical Chemistry	03
7.	PSCHLC307	PSCC	Laboratory Course: Organic Chemistry	03
Semester-IV				
1.	PSCHTE401	PSEC	Analytical Chemistry	04
2.	PSCHTE402	PSEC	Organotransition Metal Chemistry	04
3.	PSCHTE403	PSEC	Bioinorganic and Supramolecular Chemistry	04
4.	PSCHTE404	PSEC	Solid State Chemistry	04
5.	PSCHTE405	PSEC	Polymer Chemistry	04
6.	PSCHTE406	PSEC	Chemistry of Materials	04
7.	PSCHTE407	PSEC	Heterocyclic Chemistry and Asymmetric Synthesis	04
8.	PSCHTE408	PSEC	Organic Synthesis	04
9.	PSCHTE409	PSEC	Chemistry of Natural Products and Molecular Rearrangements	04
10.	PSCHTO410	PSOCC	Chemistry in Daily life	04
11.	PSCHLE411	PSEC	Laboratory Course: Inorganic Chemistry	08
12.	PSCHLE412	PSEC	Laboratory Course: Physical Chemistry	08
13	PSCHLE413	PSEC	Laboratory Course: Organic Chemistry	08
NOTE: The students of Chemistry Department in IIIrd and IVth semester will register for a minimum of 4 credits of courses in each semester from other departments.				

PATTERN OF EXAMINATION

Theory

There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test shall have marks weightage of 60% and its duration will be of 03 hours. **Minorï I** will be held after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minorï II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.

The major test will be held at the end of semester on completion of 41% to 100% of the syllabus. This test will have seven questions (each of twelve marks). The students have to attempt five questions in all. Question no. 1 (short answer type) will be compulsory and will be set out from 40% of syllabus covered in Minor I & II. The remaining six questions will be from across the syllabus of 41% to 100% i.e. beyond Minor I & II. The student has to attempt any four questions out of six questions.

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

NOTE: *Candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will not be allowed to take Major Test. Such candidates shall re-appear in the Minor Test/s only once in which he/she has failed to be conducted alteast fifteen days before the Major Test.*

DETAILED SYLLABUS

Course No.: **PSCHTC101** Course Category: **PSCC**
Title: **Theories of Bonding and Inorganic Reaction Mechanism**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examination to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Stereochemistry and Bonding in Main Group Compounds
VSEPR model, Bent rule, energetics of hybridization, structure and hybridization, d´ï p´ bonds, structure and bonding in condensed phosphates, silicates, cyclophosphazenes and Sï N cyclic compounds.

Metal Ligand Equilibria in Solution
Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry.

Theories of Bonding
Crystal field theory and its limitations, evidence of metal-ligand orbital overlap, molecular orbital theory, MO energy level diagrams for octahedral, tetrahedral and square planar complexes.

Reaction Mechanism of Transition Metal Complexes-I
Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, Kinetic applications of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage.

Reaction Mechanism of Transition Metal Complexes-II
Substitution reactions in square planar complexes, the Trans effect, mechanism of the substitution reaction, Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer-sphere reactions, cross reactions and Marcus and Hush theory, inner sphere reactions.

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BOOKS RECOMMENDED

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
3. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
4. Magneto Chemistry, R.L. Carlin, Springer Verlag.
5. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McClaverty, Pergamon.

DETAILED SYLLABUS

Course No.: **PSCHTC102** Course Category: **PSCC**
Title: **Quantum Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Exact quantum mechanical results
Schrodinger equation and the postulates of quantum mechanics. Operator concept, some properties of quantum mechanical operators. Linear and Hermitian operators. Schrodinger wave equation for Hydrogen atom, separation into three equations, quantum numbers and their importance. Radial and angular wave functions (Spherical harmonics).
Complete solution of Schrodinger equation for the following model systems: Particle in a box (1 and 3 dimensional).Concept of degeneracy. The solution of problems of harmonic oscillator & the rigid rotator.Calculation of various average values for the above systems.

Angular momentum and electronic structure of atom
General theory of angular momentum. Eigen functions and Eigen values of angular momentum operators. Ladder operators. Spin angular momentum, antisymmetry and Pauli's principle.
Electronic configuration, Russell-Saunders terms and coupling schemes, Slater determinant. Atomic term symbols, term separation of p^n configurations, spin-orbit coupling, Zeeman splitting, virial theorem.

Approximation methods
The Variation theorem, linear variation principle. Perturbation theory -first order (non-degenerate). Application of variation method and perturbation method to helium atom.

Chemical Bonding
Molecular orbital theory, LCAO-MO approximation, H_2^+molecular ion, calculation of energy levels from wave functions, physical picture of bonding and antibonding wave function, brief introduction to H_2. Valence bond treatment of H_2, comparison of MO and VB methods.

HMO method and its applications
Huckel's MO theory of conjugated systems; Application to ethylene, butadiene, cyclobutadiene. Calculation of properties- Delocalization energy, electron density and bond order.

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BOOKS RECOMMENDED

1. Physical Chemistry, P. W. Atkins, ELBS Oxford, 1997.
2. Introduction to Quantum Chemistry, A. K. Chandra, TataMcGraw Hill, 1997.
3. Quantum Chemistry, Ira. N. Levine, Prentice Hall, 2000.
4. Molecular Quantum Mechanics, P. W. Atkins and R. S. Friedmann, Oxford, 1997.
5. Quantum Chemistry, Prasad, New Age Publishers, 2000.
6. Quantum Chemistry and Spectroscopy (Problems and solution), Madan S. Pathania.

DETAILED SYLLABUS

Course No.: **PSCHTC103** Course Category: **PSCC**
Title: **Organic Reaction Mechanism- I**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Nature of bonding in organic molecules
Delocalized chemical bonding-conjugation, cross-conjugation, resonance, hyperconjugation, tautomerism.
Aromaticity in benzenoid and non-benzenoid compounds, alternant and non-alternant hydrocarbons. Huckelôs rule, energy level of molecular orbitals, annulenes, antiaromaticity, homo-aromaticity, crown ether complexes and cryptands, inclusion compounds, cyclodextrins.

Stereochemistry
Conformational analysis of cyclohexanes, decalins, effect of conformation on reactivity, steric strain due to unavoidable crowding.
Elements of symmetry, chirality, R&S configuration, molecules with more than one chiral center, threo- and erythro- isomers, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, groups and faces, optical activity in the absence of chiral carbon (biphenyls, allenes and spiranes). Stereochemistry of the compounds containing nitrogen and sulfur.

Reaction Mechanism: Structure and Reactivity
Types of mechanisms, thermodynamic and kinetic requirements, kinetic and thermodynamic control, Hammondôs postulate, Curtin-Hammett principle, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.
Structure, stability and reactivity of carbenes and nitrenes. Effect of structure on reactivity ï resonance and field effects, steric effect, qualitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants.

Aliphatic Nucleophilic Substitutions - I
The S_N2, S_N1, mixed S_N1 and S_N2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by ů and ´ bonds. Classical and non-classical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements (Pinacol-Pinacolone, Wagner-Meerwin).
The S_Ni mechanism.

Aliphatic Nucleophilic Substitutions-II
Nucleophilic substitutions at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium; phase transfer catalysis and ultrasound, ambident nucleophile and regioselectivity.

Aliphatic Electrophilic Substitution
Bimolecular mechanism: S_E2 and S_E1. Electrophilic substitutions accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

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BOOKS RECOMMENDED

1. Advanced Organic Chemistry, Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advance Organic Chemistry, F.A. Carey & R.J. Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Corell University Press.
5. Organic Chemistry, R.T. Morrison & R.N. Boyd, Prentice Hall.
6. Stereochemistry of Organic Compounds, D. Nasipuri.
7. Organic Synthesis, Michael B. Smith, McGraw Hill.

DETAILED SYLLABUS

Course No.: **PSCHTC104** Course Category: **PSCC**
Title: **Principles of Spectroscopy**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Unifying Principles
Electromagnetic Radiation, characterization, quantization of energy, Regions of emr, interaction of emr with matter, Phenomenon related to radiation-Transmission, reflection, refraction, dispersion, polarization.
Width and intensity of spectral lines, Factors contributing to this effect: Collision broadening, Doppler broadening, Heisenbergôs uncertainty principle, Transition probability, Population of states and Path length of sample, Results of time dependent Perturbation theory: Stimulated (Induced) absorption, Stimulated and spontaneous emission, Einstein coefficients, Lasers.

Microwave Spectroscopy
Rotational spectroscopy of diatomic molecules based on rigid approximation. Determination of bond length and/or atomic masses from microwave data. Effect of isotopic substitution. Non-rigid rotator. Classification of polyatomic molecules. Energy levels and spectra of symmetric top molecules and asymmetric top molecules.

Vibrational Spectroscopy
Normal coordinate analysis of homonuclear and heteronuclear diatomic molecules. Extension to polyatomic linear molecules. Derivation of selection rules for diatomic molecules based on Harmonic oscillator approximation. Force constants and amplitudes. Anharmonic oscillator. Overtones and combination bands.
Dissociation energies from vibrational data. Vibration-rotation spectra, P, Q and R branches. Breakdown of the Born-Oppenheimer approximation. Nuclear spin effect.

Raman Spectroscopy
Stokes and anti-stokes lines. Polarizability ellipsoids. Rotational and Vibrational Raman spectroscopy. Selection rules. Polarization of Raman lines.

X-ray Diffraction
Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identifications of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis.

Electron diffraction
Scattering intensity and scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules, electron diffraction studies of some compounds, low energy electron diffraction (LEED) and structure of surfaces, applications of LEED.

Neutron Diffraction
Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

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BOOKS RECOMMENDED

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Physical Methods in Chemistry, R.S. Drago, Saunders College.
3. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
4. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
5. Fundamentals of molecular spectroscopy, C.N. Banwell and E.M. McCash, Tata McGraw Hill.
6. Solid State Chemistry and its applications, A.R. West, John Wiley & Sons.
7. Solid State Chemistry: An Introduction, L. Smart and E. Moore, Nelson Thrones Ltd., UK.

DETAILED SYLLABUS

Course No.: **PSCHLC105** Course Category: **PSCC**
Title: **Laboratory Course: Inorganic Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Inorganic Chemistry

1. **Qualitative analysis of less common (rare) metals**
   Analysis of mixture containing less common metal ions : Tl, W, Mo, Se, Te, Zr, Ti, Ce, Th, V, U, Li (four metal ions in cationic/anionic forms)

2. **EDTA titrations**
   (i) Determination of copper, nickel, magnesium
   (ii) Back titration
   (iii) Alkalimetric titration
   (iv) Titration of mixtures using masking and demasking agents
   (v) Determination of hardness of water

3. **Analysis of mixtures by gravimetric and volumetric methods from the mixture solutions:**
   (i) Copper- Nickel
   (ii) Copper -Magnesium
   (iii) Copper-Zinc
   (iv) Iron-Magnesium
   (v) Silver-Zinc
   (vi) Copper-Nickel-Zinc
   (vii) Fe(II)-Fe(III)

PATTERN OF EXAMINATION

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Vogalôs Qualitative Inorganic Analysis, 7th Edn. Pearson Education Ltd.
2. Vogalôs Textbook of Quantitative Inorganic Analysis, 4th Edn., Longman Group Limited, London.
3. Applied Analytical Chemistry: Vermani.
4. Quantitative Analysis; 6th edn; Day, Underwood (Printice Hall, 1993).
5. Analytical Chemistry, 6 th Ed; D. Christian, Wiley.

DETAILED SYLLABUS

Course No.: **PSCHLC106** Course Category: **PSCC**
Title: **Laboratory Course: Physical Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Physical Chemistry

Number of hours for each experiment: 3-4 hours
A list of experiments under different headings is given below. Typical experiments are to be selected from each type. Students are required to perform at least 30 experiments.

Error Analysis and Statistical Data Analysis

Errors, types of errors, minimization of errors, error distribution curves, precision, accuracy and combination; statistical treatment for error analysis, student άô test, null hypothesis, rejection criteria, F&Q test; linear regression analysis, curve fitting, calibration of volumetric apparatus, burette, pipette and standard flask.

Phase Equilibria

To construct the phase diagram for three component system (e.g. Chloroform-acetic acid-water, ethanol-benzene-water, ethanol-ethylacetate-water, acetic acid-benzene-water).

Chemical Kinetics

i) Determination of the effect of (a) change of temperature (b) change of concentration of reactants and catalyst and (c) ionic strength of media on the velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
ii) Determination of velocity constant of hydrolysis of an ester/ionic reaction in micellar media.
iii) Determination of the rate constant for the oxidation of iodine ions by hydrogen peroxide studying the kinetics as an iodine clock reaction.
iv) Flowing clock reactions.
v) Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsonted relationship (iodide ion is oxidized by persulaphate ion).

Solutions

i) Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.
ii) Determination of the degree of disassociation of weak electrolyte and to study the deviation from ideal behavior that occurs with a strong electrolyte.

Viscosity

i) Determination of molecular weight of high polymer(polystyrene) from viscosity measurements.

Surface-Tension

Study of variation of surface tension of solution with concentration and determination of surface excess. Study of interfacial tension between two immiscible liquids CMC from surface-tension measurements.

PATTERN OF EXAMINATION

Practical

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BOOKS RECOMMENDED

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findleyôs Practical Physical Chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Experiments in Physical Chemistry by Shoemaker.
5. Practical Physical Chemistry, Viswanathan and Raghavan.
6. Advanced Physical Chemistry, J.B. Yadav, Goel Publishing House.

DETAILED SYLLABUS

Course No.: **PSCHLC107** Course Category: **PSCC**
Title: **Laboratory Course: Organic Chemistry**
Credits: **02** Maximum Marks: **50**
No.of hours**: 30**

Syllabus for the examinations to be held in Dec. 2018, Dec. 2019 & Dec. 2020.

Organic Chemistry

Quantitative Analysis
Separation, purification and identification of compounds of binary mixture (one liquid and one solid) using TLC and column chromatography, chemical tests, IR spectra to be used for functional group identification.

Organic Synthesis
Acetylation: Acetylation of Cholesterol and separation of cholesteryl acetate by column chromatography.
Oxidation: Adipic acid by chromic acid oxidation of cyclohexanol.
Grignard reaction: synthesis of triphenylmethanol from benzoic acid.
Aldol condensation: Dibenzal acetone and benzylidene acetone from benzaldehyde .

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BOOKS RECOMMENDED

1. Experiments and techniques in Organic Chemistry, D. Pasto, C. Johnson and M.Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middlenton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogelôs Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley

DETAILED SYLLABUS

Course No.: **PSCHTC201** Course Category: **PSCC**
Title: **Group Theory and Transition Metal Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

Symmetry and Group theory in Chemistry
Symmetry elements and symmetry operations, definition of group, subgroup. Point symmetry group, Schonfilies symbols, Conjugacy relation and classes, representations of symmetry operations by matrices. Character of a representation. The great orthogonality theorem (without proof). Derivation of character tables for C_{2v}, C_{3v} and C_{2h}. Use of character tables in spectroscopy, symmetry aspects of molecular vibrations of H_2O molecule.

Electronic spectra of transition metal complexes
Spectroscopic ground states, correlation diagrams, selection rules and their breakdown, Orgel diagrams, Tanbe-Sugano diagrams and spectra of transition metal complexes (d^1 to d^9 states), significances of Dq, B and ϐ parameters, Jahn-Teller effect, Nephelauxetic effect, charge transfer spectra.

Magnetic properties of transition metal complexes
Magnetic susceptibility, magnetic moments, Quenching of magnetic moments, spin-orbit coupling, anomalous magnetic behaviour of metal complexes, magnetic exchange and spin-state crossovers.

Metal π-complexes – I
Metal carbonyls, preparation and important reactions of metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation.

Metal π-complexes – II
Prepartation, bonding, structure and important reactions of transition metal, nitrosyls, dinitrogen and dioxygen complexes, ligating behavior of tertiary phosphines.
Isopoly and heteropoly acids and salts of molybdenum and tungsten.

PATTERN OF EXAMINATION

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There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test shall have marks weightage of 60% and its duration will be of 03 hours. **Minorï I** will be held after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minorï II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.
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NOTE: *Candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will not be allowed to take Major Test. Such candidates shall*

re-appear in the Minor Test/s only once in which he/she has failed to be conducted alteast fifteen days before the Major Test.

BOOKS RECOMMENDED

1. Symmetry and Spectroscopy of molecules, K.V. Reddy, New Age International Publishers.
2. Group Theory and Symmetry in Chemistry, Kamlesh Bansal, Campus Book International.
3. Symmetry and Structure, S.F.A. Kettle, Wiley.
4. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
5. Inorganic Chemistry, J.E. Huhey, Harpes & Row.
6. Chemistry of the Elements, N.N. Greenwood and A. Earnshow, Pergamon.
7. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
8. Magnetochemistry, R.L. Carlin, Springer Verlag.
9. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McClaverty, Pergamon.

DETAILED SYLLABUS

Course No.: **PSCHTC202** Course Category: **PSCC**
Title: **Chemical Dynamics, Surface and Electro Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

Chemical Dynamics – I

Collision theory of reaction rates, steric factor, activated complex theory, Arrhenius equation and the activated complex theory; ionic reactions, kinetic salt effects, steady state kinetics, kinetic and thermodynamic control of reactions.

Pyrolysis of acetaldehyde, decomposition of ethane, photochemical and thermal reaction between hydrogen and bromine, Photochemical reaction between hydrogen and chlorine, oscillatory reactions (Belousov-Zhabotinsky reaction). Homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method and flash photolysis.

Chemical Dynamics – II

Dynamics of molecular motions, dynamics of unimolecular reactions (Lindemann, Hinshelwood and Rice-Ramsperger-Kassel (RRK) theories of unimolecular reactions). Kinetics of decomposition of N_2O_5.

Macromolecules

Polymer-definition, types of polymers, electrically conducting polymers, kinetics of polymerization, mechanism of polymerization.

Molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, sedimentation and light scattering methods), chain configuration of macromolecules, calculation of average dimensions of various chain structures.

Surface Chemistry

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equation), Vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, BET equation, estimation of surface area, surface films on liquids, Catalytic activity at surfaces.

Micelles

Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactants, counter ion binding of micelles, thermodynamics of micellization-phase separation and mass action models, solubilization, micro emulsion, reverse micelles.

Electrochemistry-I

Debye-Huckel limiting law, Debye-Huckel-Onsagar treatment and its extension. Debye-Huckel-Jerum mode, Thermodynamics of electrified interfaces. Lippman equation, Method of determination of surface excess, Structure of electrified interfaces: Helmholtz-Perrin, Guoy-Chapman, Stern models.

Over potential, exchange current density, derivation of Butler-Volmer equation, Tafel plot.

Electrochemistry-II

Analogies between semiconductor and electrolyte, Structure of semiconductor-electrolyte interface, The diffuse charge region inside an intrinsic semiconductor (The Garrett-Brattain Space), Differential capacity due to space charge.

Bioelectro Chemistry: Cells, membranes and mitochondria, membrane potentials, older and modern theories of membrane potentials, Electrochemical mechanism of nervous system: General and facts.

Nernst-planck equation, electrocardiography. Polarography theory, Ilkovic equation; half wave potential and its significance.

Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention methods.

PATTERN OF EXAMINATION

Theory

There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test shall have marks weightage of 60% and its duration will be of 03 hours. **Minor**ï **I** will be held after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minor**ï **II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.

The major test will be held at the end of semester on completion of 41% to 100% of the syllabus. This test will have seven questions (each of twelve marks). The students have to attempt five questions in all. Question no. 1 (short answer type) will be compulsory and will be set out from 40% of syllabus covered in Minor I & II. The remaining six questions will be from across the syllabus of 41% to 100% i.e. beyond Minor I & II. The student has to attempt any four questions out of six questions.

NOTE: *Candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will not be allowed to take Major Test. Such candidates shall re-appear in the Minor Test/s only once in which he/she has failed to be conducted alteast fifteen days before the Major Test.*

BOOKS RECOMMENDED

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Chemical Kinetics, K.J.Laidler, Mcgraw-Hill.
3. Kinetics and mechanism of Chemical Transformations, J.Rajaraman and J. Kuiacose, McMillan.
4. Micelles, Theoretical and Applied Aspects, V.Moroi, Plenum.
5. Modern Electrochemistry Vol. 1, Vol. 2A and Vol. 2B, J.O.M. Bockris and A.K.N.Reddy, Plenum.
6. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.

DETAILED SYLLABUS

Course No.: **PSCHTC203** Course Category: **PSCC**
Title: **Organic Reaction Mechanism- II**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

Aromatic Electrophilic & Nucleophilic Substitutions
The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation of other ring systems. Friedel-Crafts reaction of alkenes and alcohol substrates, Vilsmier reaction. Gattermann-Koch reaction.
Aromatic Nucleophilic Substitutions
The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity effect of substrate structure, leaving group and attacking nucleophiles. The Von Richter, Sommelet-Hauser and Smiles rearrangements.

Addition of Carbon-Carbon Multiple Bonds & Elimination Reactions
Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity, addition to cyclopropane ring, hydroboration, Michael reaction, Sharpless asymmetric epoxidation.

Elimination Reactions
The E2, E1 and E1cB mechanisms. Base and stereoelectronic effect on E2/S_N2 competition; E1/S_N1 competition. Orientation of the double bond. Reactivity: effects of substrate structures, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic eliminations; Peterson olefination.

Addition to Carbon-Hetero Multiple Bonds
Mechanisms of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction.
Mechanism of condensation reactions involving enolates ï Aldol, Knoevenagel, Claisen and Stobbe Condensation.
Enamine based Aldol reaction. Hydrolysis of esters and amides.

Pericyclic Reactions
Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, and 1,3,5-hexatriene system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions, 4n and 4n+2 systems. Cycloadditions: antrafacial and suprafacial additions, 4n and 4n+2 systems, 1,3-dipolar cycloadditions.
Sigmatropic rearrangements-suprafacial and antrafacial shifts of H, Sigmatropic shifts involving carbon moieties, Claisen, Cope and Ene reaction.

Free Radical Reactions
Types of free radical mechanisms (substitution at an aromatic substrate), neighbouring group assistance: reactivity (at an aliphatic, aromatic substitute and at bridge head). The effect of

solvent and attacking radicals on reactivity. Allylic halogenations (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction and Hunsdiecker reaction.

PATTERN OF EXAMINATION

Theory

There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test shall have marks weightage of 60% and its duration will be of 03 hours. **Minor**ï **I** will be held after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minor**ï **II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.

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BOOKS RECOMMENDED

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerrry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K. Ingold, Cornell University Press.
5. Organic Chemistry, R.T. Morrison and R.N. Boyd, Prentic-Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional.
8. Pericyclic Reactions, S.M. Mukherji, Macmillan, India.
9. Reaction Mechanism in Organic Chemistry, S.M. Mukherji and S.P. Singh, Macmillan.
10. Advanced Organic Chemistry: Reaction Mechanisms, Reinhard Bruckner, Academic Press, USA.

DETAILED SYLLABUS

Course No.: **PSCHTC204** Course Category: **PSCC**
Title: **Applications of Spectroscopy in Organic Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

Ultraviolet and Visible Spectroscopy
Various electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fieser-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls.

Optical Rotatory Dispersion (ORD) and Circular Dichorism (CD)
Definition, deduction of absolute configuration, octant rule for ketones.

Infrared Spectroscopy
Basic principles, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance.

Nuclear Magnetic Resonance Spectroscopy
General introduction and definition, larmour frequency, chemical shift, spin-spin interaction, shielding mechanism, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides and mercapto), chemical exchange, effect of deuteration, complex spin-spin interaction between two, three, four and five nuclei (first order spectra), virtual coupling. Stereochemistry: hindered rotation, Karplus curve-variation of coupling constant with dihedral angle. Simplification of complex spectra: nuclear magnetic double resonance, contact shift reagents, solvent effects, Fourier transform techniques, nuclear Overhauser effect (NOE). Resonance of other nuclei ï F, P.

Carbon-13 NMR Spectroscopy
General considerations, chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl carbon). Two dimensional NMR spectroscopy ï COSY, NOESY, DEPT, INEPT, APT and INADEQUATE techniques.

Mass Spectrometry
Introduction, ion production ï El, Cl, FD and FAB, factors affecting fragmentation of organic compounds, common functional groups, molecular ion peak, metastable peak, McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation of organic compounds with respect to their determination. Introduction to modern MS techniques (MALDI, ESI).

PATTERN OF EXAMINATION
Theory

There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test shall have marks weightage of 60% and its duration will be of 03 hours. **Minor**ï **I** will be held after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minor**ï **II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.

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BOOKS RECOMMENDED

1. Physical Methods for Chemistry, R.S. Drago, Saunders Company.
2. Structural Methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H. Rankin and S. Cradock, ELBS.
3. Infrared and Raman Spectra: Inorganic and Coordination Compounds, K. Nakamoto, Wiley.
4. Progress in Inorganic Chemistry, Vol. 8 ed., F.A. Cotton, Vol. 15 ed., S.J. Lippard, Wiley.
5. Transition Metal Chemistry, ed. R.L. Carlin, Vol. 3, Dekker.
6. Inorganic electronic Spectroscopy, A.P.B. Lever, Elsevier.
7. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Horwood.
8. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
9. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley.
10. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Wiley.
11. Application of Spectroscopy of Organic Compounds, J.R. Dyer, Prentice Hall.
12. Spectroscopic Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata McGraw Hill.
13. Organic Spectroscopy, William Kemp.

DETAILED SYLLABUS

Course No.: **PSCHLC205** Course Category: **PSCC**
Title: **Laboratory Course: Inorganic Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**
Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

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1. Volumetric Analysis:

(a) Potassium iodate titrations: Determination of iodide, hydrazine, antimony(III) and arsenic (III)

(b) Potassium bromate titrations

(i) Determination of antimony (III) and arsenic (III) (Direct Method)

(ii) Determination of aluminium, cobalt and zinc (by oxine method)

2. Commercial Analysis:

(i) Determination of available chlorine in bleaching powder

(ii) Determination of Oxygen in hydrogen peroxide.

(iii) Determination of Phosphoric acid in commercial phosphoric acid.

(iv) Determination of Boric acid in borax.

(iv) Analysis of Ores (Dolomite, Pyrolusite) and alloys (Coin, Brass, Bronze).

3. Green methods of preparation of the following:

(i) Bis(acetylacetonato)copper(II)

(ii) Tris(acetylacetonato)iron(III)

(iii) Tris(acetylacetonato)manganese(III)

(iv) Bis(ethylenediammine)dioxolatocobolt(III) chloride dihydrate

(v) trans-dichlorobis(ethylenediammine)cobalt(III) chloride

(vi) Vanadyl acetylacetonate

(vii) cis-Potassiun diaquadioxalatochromate(III) dihydrate

(viii) trans- Potassiun diaquadioxalatochromate(III) dihydrate

PATTERN OF EXAMINATION

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Synthesis and Characterization of Inorganic Compounds, William L. Jolly, Prentice Hall.
2. Vogalôs Textbook of Quantitative Inorganic Analysis, 4th Edn., Longman Group Limited, London.
3. A text Book of Quantitative Inorganic Analysis: A.I.Vogal.
4. Applied Analytical Chemistry: Vermani.
5. Commercial Methods of Analysis: Shell & Biffen

DETAILED SYLLABUS

Course No.: **PSCHLC206** Course Category: **PSCC**
Title: **Laboratory Course: Physical Chemistry**
Credits: **02** Maximum Marks: **50**
No.of hours**: 30**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

Heat of solution:
To study the heat of solution of benzoic acid/oxalic acid by solubility method at different temperatures and the effect of electrolyte on it.

Adsorption:
Study the adsorption of oxalic acid on charcoal and hence check the validity of Langmuir adsorption isotherm and classical adsorption isotherm.

Critical solution temperature:
Determine the mutual solubility curve of phenol and water and hence find its consolute temperature and the effect of electrolyte on the system.

Abbe's refractometer:
Determine the refractive indices of given organic liquid at room temperature

pH meter and Conductivity meter:
Determine the pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence determine the dissociation constant of acid.
Determine the strength of strong and weak acid and their mixture using pH metry.
Determine the strength of strong and weak acid and their mixture using conductivity meter.
Study of kinetics of second order reaction using conductivity ï meter .

Phase-Equilibria
Phase diagram of two component eutectic systems (Naphthalene-benzoic acid; acetamide-benzoic acid; naphthalene-diphenyl).

Phase diagram of two component compound forming systems (salicylic acid ï benzamide, acetamide-ɓ-naphthol).

PATTERN OF EXAMINATION
Practical
The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findleyôs Practical Physical Chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Experiments in Physical Chemistry by Shoemaker.
5. Practical Physical Chemistry by Viswanathan and Raghavan.
6. Advanced Practical Physical Chemistry by J.B. Yadav, Goel Publishing House.

DETAILED SYLLABUS

Course No.: **PSCHLC207** Course Category: **PSCC**
Title: **Laboratory Course: Organic Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**

Syllabus for the examinations to be held in May 2019, May 2020 & May 2021.

Organic Chemistry

a. **Organic Synthesis:** Sandmeyer reaction: p-Chlorotoluene from p-toluidine. Acetoacetic ester condensation: Synthesis of ethyl-n-butylacetoacetate by A.E.E. condensation. Cannizzaro reaction: Benzaldehyde and 4-chlorobenzaldehyde as substrates. Knoevenagel Condensation: Synthesis of cinnamic acid. Friedel Crafts Reaction: ß-Benzoyl propionic acid from succinic anhydride and benzene. Aromatic electrophilic substitutions: Synthesis of p-nitroaniline and p-bromoaniline. Beckmann rearrangement of acetophenone and benzophenone oximes.
The products may be characterized by spectral techniques.

b. Separation and identification of organic compounds from two component mixture.

c. **Quantitative Analysis:** Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method. Estimation of amines/phenols and glucose using bromated bromide solution/acetylation method. Determination of iodine and saponification values of an oil sample. Determination of DO, COD and BOD of water sample.

PATTERN OF EXAMINATION

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Experiments and techniques in Organic Chemistry, D. Pasto, C. Johnson and M.Miller, Prentice Hall.
2. Macroscale and Microscale Organic Experiments, K.L. Williamson, D.C. Heath.
3. Systematic Qualitative Organic Analysis, H. Middlenton, Adward Arnold.
4. Handbook of Organic Analysis-Qualitative and Quantitative, H. Clark, Adward Arnold.
5. Vogelôs Textbook of Practical Organic Chemistry, A.R. Tatchell, John Wiley.

DETAILED SYLLABUS

Course No.:**PSCHTC301** Course Category: **PSCC**
Title: **Photochemistry and Spectroscopy in Inorganic Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2019, Dec. 2020 & Dec. 2021.

Ligand Field Photochemistry

Types of excited states of coordination compounds: Ligand field, intra-ligand and Charge-transfer excited states,

Ligand field photochemistry of Cr(III) complexes, photolysis rules, photochemistry of mixed ligand Cr(III) complexes, stereochemistry, role of doublet and quartet excited states, experimental evidences.

Photosubstitution and photoredox reaction of Co(III) complexes, photosubtitution reactions of Rh(III) complexes.

Photoelectrochemistry

Introduction, Equilibium state at a semiconductor/liquid junction, Qualitative description of interfacial charge equilibration; depletion, depletion width, Quantitative description of interfacial charge equilibration; electric field and electric potential, Charge transfer at a semiconductor/liquid junction, Current-voltage characteristics of semiconductor electrode, energy conversion properties, Strategies for design of semiconductor-liquid junctions for energy conversion.

Vibrational Spectroscopy

Symmetry and shape of AB_2, AB_3, AB_4, AB_5 and AB_6 molecules. Mode of bonding of ambidentate ligands, nitro, thiocyanato, ethylenediamine and diketonato complexes,

Raman Spectroscopy: Stokes and anti-stokes lines, polarisability of ellipsoids, Rotational and vibrational Raman spectroscopy, Selection rules, Resonance Raman spectroscopy, Basic understanding and its applications particularly for study of active sites of metalloproteins.

Electron Spin Resonance Spectroscopy

Basic Principle, spin Hamiltonian, Hyperfine coupling, spin polarization and McConnell relationship, Isotropic and anisotropic hyperfine coupling constants, spin-orbit coupling and significance of g- tensor, Applicaion to transition metal complexes(having one unpaired electron) including biological systems and inorganic free radical viz. BF_2, F_2, PH_4 etc.

Mossbauer Spectroscopy

Basic Principles, spectral parameters and spectrum display, Application of the technique to the studies of :

(a) bonding and structure of Fe^{2+} and Fe^{3+} compounds including those of intermediate spin,
(b) Sn^{2+} and Sn^{4+} compounds, nature of M-L bond, coordination number, and structure and
(c) Detection of oxidation state and inequivalent MB atoms.

Nuclear Magnetic Resonance of Paramagnetic Substances in Solution

The chemical shift in Diamagnetic and Paramagnetic molecules, The contact and Pseudo-contact shifts, factors affecting nuclear relaxation,

PATTERN OF EXAMINATION

Theory

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BOOKS RECOMMENDED

1. Principles and Applications of Semiconductor Photoelectrochemistry, Progress in Inorganic
   Chemistry, Volume 41, Kenneth D. Karlin
2. Concepts of Inorganic Photochemistry, A. W. Adamson and P. D. Fleischauer, Wiley.
3. Physical Methods for Chemistry, R. S. Drago, Saunders Company.
4. Infrared and Raman Spectra : Inorganic and coordination compounds, K. Nakamoto, Wiley.
5. Structural Methods in Inorganic Chemistry, E.A. V. Ebsworth, D. W. H. Rankin and S. Cradock, ELBS.
6. Progress in Inorganic Chemistry, Vol. 8, ed., F. A. Cotton, Vol. 15, ed. S.J. Lippard, Wiley.
7. Applications of physical methods to Inorganic and Bioinorganic Chemistry, Robert A. Scott, Charles M. Lukehart, Wiley.

DETAILED SYLLABUS

Course No.: **PSCHTC302** Course Category: **PSCC**
Title: **Thermodynamics and Statistical Mechanics**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2019, Dec. 2020 & Dec. 2021.

Non Equilibrium Thermodynamics
Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g. heat flow, chemical reaction etc.) transformation of the generalized fluxes and forces, non equilibrium stationary states, phenomenological equations, microscopic reversibility and Onsagerôs reciprocity relations, electrokinetics phenomena, diffusion, electric conduction, irreversible thermodynamics for biological systems, coupled reactions.

Transport Phenomenon
Mass Transport: Diffusion, Diffusion coeffieicnt, Fickôs first and second laws, Einstein-Smoluchowski equation, Thermal conductivity, Viscosity of gases and fluids, Einstein relation, Nernst-Einstein equation, Stokes-Einstein equation, relation between flux and viscosity, diffusion coefficient and mean free path, thermal conductivity/viscosity and mean free path, Sedimentation and centrifugation, Ionic conduction.

Thermodynamics of Mixtures
Brief resume of classical concepts of thermodynamics inluding free energy, chemical potential and entropies, partial molar properties: partial molar free energy, partial molar volume and partial molar heat content and their significances. Determinations of these quantities. Concepts of fugacity and determination of fugacity.
Non ideal systems: Excess functions for non-ideal solutions. Activity, activity coefficient, Debye-Huckel theory for activity coefficient of electrolytic solutions: determination of activity and activity coefficients: ionic strength.

Statistical Mechanics
Role of statistical mechanics, Ensemble: Micro canonical, canonical and grand canonical, postulates of ensemble averaging, phase space, Stirlingôs approximation, occupation number, micro and macro states, statistical weight factor, probability, concept of distribution, thermodynamic probability, types of statistics: Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics, most probable distribution of three types of statistics, Lagrangeôs undetermined multipliers, evaluation of ß, comparison of three statistics, molecular partition function and its significance, thermodynamic properties in terms of partition function, numericals

Applications of statistical mechanics
Factorisation of molecular partition function, canonical ensemble partition function (Independent and distinguishable molecules or particles; independent and indistinguishable molecules or particles), evaluation of translational, rotational, vibrational, electronic and nuclear partition functions, contribution of translational, rotational and vibrational partition functions to thermodynamic functions, effect of nuclear spin on diatomic molecules, equilibrium constant of ideal gas in terms of partition function. Heat capacities of solids: the Einstein theory and the Debye theory, numerical.

PATTERN OF EXAMINATION

Theory

There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test shall have marks weightage of 60% and its duration will be of 03 hours. **Minor**ï **I** will be held after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minor**ï **II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.

The major test will be held at the end of semester on completion of 41% to 100% of the syllabus. This test will have seven questions (each of twelve marks). The students have to attempt five questions in all. Question no. 1 (short answer type) will be compulsory and will be set out from 40% of syllabus covered in Minor I & II. The remaining six questions will be from across the syllabus of 41% to 100% i.e. beyond Minor I & II. The student has to attempt any four questions out of six questions.

NOTE: *Candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will not be allowed to take Major Test. Such candidates shall re-appear in the Minor Test/s only once in which he/she has failed to be conducted alteast fifteen days before the Major Test.*

BOOKS RECOMMENDED

1. Theoretical Chemistry: S. Glasstone.
2. Statistical Thermodynamics: M.C. Gupta.
3. Physical Chemistry: P.W. Atkins.
4. Chemical Thermodynamics: R.P. Rastogi and R.R. Misra.
5. Statistical Mechanics and Properties of Matter: E.S.R. Gopal.
6. Statistical Mechanics, D.A. McQuarrie.
7. Thermodynamics of Irreversible Processes, Rolf Haase.
8. Fundamental of Chemical Thermodynamics, E.N. Yeremin.
9. Introduction to Irreversible Thermodynamics, Prgogine.
10. Modern Thermodynamics, D. KondePudi and I. Prigogine.
11. Physical Chemistry, Engel and Reid.

DETAILED SYLLABUS

Course No.: **PSCHTC303** Course Category: **PSCC**
Title: **Bio-Organic and Medicinal Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in Dec. 2019, Dec. 2020 & Dec. 2021.

Enzymes, kinds and mechanism of enzymatic reactions
Introduction and historical perspectives, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specialization and regulation. Nomenclature and classification. Fischerôs lock and key and Koshlandôs induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labelling and enzyme modification by site-directed mutagenesis.
Orientation and steric effects in enzyme catalysis (acid, base and covalent catalysis).

Chemistry of Vitamin B-Complex and Coenzymes
Introduction, classification and nomenclature of vitamins. Occurance, functions and mechanism of action of thiamine, Riboflavin and Pantothenic acid. Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate. NAD^+, $NADP^+$, FMN, FAD, lipoic acid, vitamin B_{12}.

Drug-design
Introduction, concept of Lead compounds, Factors governing drug design and rational approach. Drug design through method of variations, disjunction and conjunction. Bioisosteric replacement, rigid analogs, homologation of alkyl chains, changes in ring size and ring position isomers, alteration of stereochemistry, fragments of lead molecules.

Synthesis and mode of action
Cardiovascular drugs: Antihypertensive and hypotensive drugs:
Hydralazine (Apresoline hydrochloride), Methyldopa (Aldomet), Procainamide (Pronestyl); Antisympathetic drugs- Propanolol (Indral), Verapamil (Isoptin) and Prenylaminelactate (Synadrin).
Antiparkinsonian Agents: Biperiden hydrochloride (Akineton hydrochloride), Ethopropazine hydrochloride (Profenamine) and Levodopa (Bendopa).
Anticancer drugs: Adriamycin, Texol, Tamoxifen [only Mode of Action].
Antihistaminic drugs: Citrizine, (Promethazine hydrochloride) and Chloropheniramine meleate (Alermine).
Antimalarials: Chloroquine phosphate (Resochin) and Mepacrine hydrochloride (Quinacrine).

Antibiotics: Introduction, classification, isolation and chemistry of Pencillins, Chloramphenicol and tetracyclines (oxy tetracycline).
Vitamins: Occurrence, chemistry, functions and mechanism of action of Ascorbic acid, Ŭ-Tocopherol and Vitamin K_1 & K_2.

PATTERN OF EXAMINATION
Theory
There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test

shall have marks weightage of 60% and its duration will be of 03 hours. **Minor**ï **I** will be held after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minor**ï **II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.

The major test will be held at the end of semester on completion of 41% to 100% of the syllabus. This test will have seven questions (each of twelve marks). The students have to attempt five questions in all. Question no. 1 (short answer type) will be compulsory and will be set out from 40% of syllabus covered in Minor I & II. The remaining six questions will be from across the syllabus of 41% to 100% i.e. beyond Minor I & II. The student has to attempt any four questions out of six questions.

NOTE: *Candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will not be allowed to take Major Test. Such candidates shall re-appear in the Minor Test/s only once in which he/she has failed to be conducted alteast fifteen days before the Major Test.*

BOOKS RECOMMENDED

1. Bio-organic Chemistry: A Chemical Approach to enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag.
2. Enzyme Chemistry: Impact and Aplications, Ed. Collin J. Suckling, Chapman and Hall.
3. Enzymatic Reaction Mechanism, C. Walsh and W.H. Greeman.
4. Immobilised Enzymes: An Introduction and Application in Biotechnology, M.D. Travan, John Wiley.
5. Enzyme Structure and Mechanism, A. Fersht and W.H. Freeman.
6. Textbook of Organic Medicinal and Pharmaceuticals Chemistry, 8th Ed., Edited by R.F. Doerge, J.B. Lippincott Co., Philadelphia 1982.
7. Pharmaceutical Chemistry in Perspective, B.G. Reuben and H.A. Wittcoff, John Wiley and Sons., N.Y.
8. Principles of Medicinal Chemistry, Lea and Febiger, Philadelphia, USA.
9. Strategies of Organic Drug Synthesis and design, D. Lendnicer, John Wiley and Sons, N.Y.
10. Burgerôs Medicinal Chemistry, Drug Discovery and Development, John Wiley and Sons.

DETAILED SYLLABUS

Course No: **PSCHTO304** Course Category: **PSOCC**
Title: **Environmental Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours: **60**

Syllabus for the examinations to be held in Dec. 2019, Dec. 2020 & Dec. 2021.

Environment:
Earthôs Atmosphere: Structure and composition of atmosphere. Temperature measurements and controls: Vertical temperature and stability of atmosphere. Biogeochemical cycle of Carbon, Nitrogen, Oxygen and Sulfur,

Soils:
Composition of soil and its profile, various micro and macro nutrients present in soil, Nitrogen, Phosphorus and Potassium in soil, Acid-base and ion exchange reactions in soils, Soil pollution due to fertilizers, pesticides and solid waste (plastics and metals).

Hydrosphere
Chemical composition of water bodies ï lakes, streams and rivers; Hydrological cycle; Types, sources and classification of water pollutants like industrial water pollution, pollution pesticide, detergent and oil pollutants. Effects of water pollutants on life and environment; Water quality parameter and their analytical methods: Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demands, Solids, contents of chloride and chlorine demand.

Industrial Pollution
Environmental implications and abetment of Cement industry, sugar mill, paper and pulp mill, thermal power plant and polymer/plastic industry. Solid Waste Management: landfill, incineration, resource reduction, recycling and reuse, composting and organic farming.

Atmosphere
Atmospheric chemistry: chemical composition of atmosphere ï particles, ions and radicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effects. Air pollution ï types and sources; depletion of stratospheric ozone, industrial and transport-related air pollution; chlorofluoro hydrocarbons, green house effect (Global warming) and acid rains.

Environmental Toxicology
Hazardous waste: Introduction, origin, transport, effects and fates; Chemical solutions to environmental problems biodegradability, principles of decomposition better industrial processes.
Bhopal gas tragedy, MIC and its impacts and Minamata disasters; Nuclear Hazards: Chernobyl and Three Mile Island

PATTERN OF EXAMINATION
Theory
There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test shall have marks weightage of 60% and its duration will be of 03 hours. **Minor**ï **I** will be held

after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minorï II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.

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BOOKS RECOMMENDED

1. Environmental Chemistry, S. E. Manahan, Lewis Publishers
2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers
3. Environmental Chemistry, A. K. De, Wiley Eastern.
4. Environmental Pollution Analysis, S. M. Khopkar, Wiley Eastern.
5. Standard Method of Chemical Analysis, F. J. Welcher, Vol. III, Van Nostrand Reinhold Co.
6. Environmental Toxicology, Ed. J. Rose, Gordon and Breach Science Publication.
7. Elemental Analysis of Airborne Particles, Ed. S. Landsberger and M. Creatchman, Gordon and Breach Science Publication.
8. Environmental Chemistry, C. Baird and W. H. Freeman.

DETAILED SYLLABUS

Course No.: **PSCHLC305** Course Category: **PSCC**
Title: **Laboratory Course: Inrganic Chemistry**
Credits: **02** Maximum Marks: **50**
No.of hours**: 30**

Syllabus for the examinations to be held in Dec. 2019, Dec. 2020 & Dec. 2021.

Preparation of selective inorganic compounds and their study by IR, electronic spectra, and magnetic susceptibility measurement. Handling of air and moisture sensitive compounds involving vacuum lines.
Selection can be made from the following:

1. Sodium amide, Inorg. Synth., 2, 128 (1946).
2. Trialkoxyboranes- Preparation, IR and NMR spectra. J. Am. Chem. Society, Vol 92, 1970.
3. Preparation of vanadylacetyacetonate; Inorg. Synth. 5, 113 (1957).
4. Preparation of tris(ethylenediamine)nickel(II)chloride; Inorg. Synth. 6, 200 (1960)
5. Preparation of tris(acetylacetonato)manganese(III); Inorg. Synth. 7, 183, (1963).
6. Preparation of tris(acetylacetonato)alumimium(III), Inorg. Synth. 7, 183, (1963).
7. Preparation of Trioxalato salts $M\hat{o}_3[M\hat{o}\hat{o}\hat{o}(C_2O_4)_3].3H_2O$ ($M\hat{o}$ = K and $M\hat{o}\hat{o}\hat{o}$ = Al, Fe, Co or Cr); Inorg. Synth. 1, 35, (1939).
8. Dichlorophenylborane-synthesis in vacuum line.

Gravimatric and Volumetric analysis: Vanadium, Nickel, Manganese, Aluminium, Chromium, Chloride (Volhardôs method) etc.

Paper Chromatography: Separation and identification of group cations

1. Separation and identification of group I cations (Pb^+, Ag^+, Cr^+).
2. Separation and identification of group II cations (Hg^{2+}, Cu^{2+}, Cd^{2+} and Bi^{2+}).
3. Separation and identification of group III cations (Fe^{3+}, Al^{3+}, Cr^{3+}).
4. Separation and identification of group IV cations (Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+}).

PATTERN OF EXAMINATION

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Vogel's textbook of quantitative chemical analysis (5^{th} and 6^{th} edition).
2. G. R. Chatwal, Instrumental Methods for Chemical Analysis, 5^{th} ed., Himalaya Publications (India).
3. V. K. Ahluwalia and S. Dingra, Advanced experimental Inorganic Chemistry, Manakin Press Pvt. Ltd., 2016.

DETAILED SYLLABUS

Course No.: **PSCHLC306** Course Category: **PSCC**
Title: **Laboratory Course: Physical Chemistry**
Credits: **03** Maximum Marks: **75**
No.of hours**: 45**

Syllabus for the examinations to be held in Dec. 2019, Dec. 2020 & Dec. 2021.

Number of hours of each experiment 3-4 hours. A list of experiments under different heading are given below .Typical experiments are to be selected from each type.

Chemical Kinetics

i) Study the kinetics of bromination of phenol by bromide-bromate mixture in an acid medium as a clock reaction.
ii) To find out the order of reaction between potassium bromate and potassium iodide.

Thermodynamics

i) Determination of partial molar volume of solute (e.g. KCl) and solvent in a binary mixture.
ii) Determination of temperature dependence of solubility of compound in two solvents having similar intermolecular interactions (benzoic acid in water and in DMSO-water mixture) and calculate the partial molar heat of solution.

Conductivity

i) Determine the hydrolysis constant of aniline hydrochloride at different temperatures conductometrically.
ii) Estimate the concentration of HCl, CH_3COOH and $CuSO_4.5H_2O$ in a given solution by carring out conductometric titration with NaOH solution.
iii) Determine the equivalent conductance of a strong electrolyte i.e. NaCl, KCl at several concentrations and hence verify Debye Huckel Onsager equation.
iv) Determine the equivalent conductance of a weak electrolyte i.e. CH_3COOH at infinite dilutionby Kohlrasch law.
v) Determine the degree of hydrolysis and hydrolysis constant of CH_3COONa, NH_4Cl.

pH metry

i) Determine the strength of unknown solution of HCl by titrating it with NaOH solution using pH meter.
ii) To find the strength of unknown solution of NH_3 solution by titrating it with CH_3COOH solution.
iii) To find the strength of unknown solution of Na_2CO_3 solution by titrating it with HCl solution.
iv) To find out the dissociation constant of polybasic acid e.g. phosphoric acid by titrating it with NaOH solution.

PATTERN OF EXAMINATION

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findleyôs Practical Physical Chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Experiments in Physical Chemistry by Shoemaker.
5. Practical Physical Chemistry by Viswanathan and Raghavan.

DETAILED SYLLABUS

Course No.: **PSCHPC307** Course Category: **PSCC**
Title: **Laboratory Course: Organic Chemistry**
Credits: **03** Maximum Marks: **75**
No. of hours**: 45**

Syllabus for the examinations to be held in Dec. 2019, Dec. 2020 & Dec. 2021.

ORGANIC CHEMISTRY

Qualitative Analysis

Separation, purification and identification of the components of a mixture of three organic compounds (three solids or two liquids and one solid, two solids and one liquid), using TLC for checking the purity of the separated compounds, chemical analysis, IR, PMR and mass spectral data.

Paper Chromatography

Separation and identification of the sugars present in the given mixture of glucose, fructose and sucrose by paper chromatography and determination of Rf values.

Spectroscopy

Identification of organic compounds by the analysis of their spectral data (UV, IR, PMR, CMR and MS).

PATTERN OF EXAMINATION

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Vogelôs text book of Quantitative analysis, revised, J. Bassett, R.C. Denney, G.H. Jaffery and J. Mendham, ELBS.
2. Experiments and techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miler, Prentice Hall.
3. Synstematic Qualitative Organic analysis, H. Middlenton, Adward Arnold.
4. Experimental Organic Chemistry, Principles and Practice, Lawrence M. Harwood and Christopher J. Moody, Blackwell Scientific Publications.
5. Spectrometric Identific of Organic compounds, R.M. Silverstein, G.C. Bassler and T.C. Marrill, John Wiley.
6. Spectroscopic methods in Organic chemistry, D.H. Williams, I. Fleming, Tata McGraw Hill.
7. Organic Spectroscopic, William Kemp.

DETAILED SYLLABUS

Course No.: **PSCHTE401** Course Category: **PSEC**
Title: **Analytical Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Separation Methods
Solvent Extraction
Liquid-liquid extraction, Principles and process of solvent extraction, Techniques of solvent extraction, Extraction by chelation, Extraction by salvation, Extraction equilibria for chelation and salvation, Extraction by ion pair formation.
Classification of chromatographic methods, Column chromatography, Adsorption phenomenon, nature of adsorbents, solvent systems, differential migration, Thin-layer chromatography (TLC), coating materials and preparation of TLC plates, solvents for development, detection of compounds in TLC, R_f value in TLC, applications of TLC in chemistry.

Ion-exchange chromatography, Principle and theory of cation-exchange and anion-exchange chromatography, Applications of ion-exchange chromatography, ion chromatography as separation technique, structure and characteristics of resins, eluants used in separation, detectors used in ion chromatography, analytical application of ion chromatography

Paper chromatography, Nature of paper-support, stationary phase, solvent system, technique of paper chromatography, various modes of development: ascending, descending and horizontal, applications.

Thermoanalytical and Electroanalytical Methods
Introduction, Thermogravimetry (TG), instrumentation, Differential thermal analysis (DTA) and differential scanning calorimetry (DSC), applications of thermal methods.
Potentiometric method: Reference electrodes and indicator electrodes. The hydrogen, calomel and Ag-AgCl electrodes, The glass electrode, performance and limitations, measurement of pH, potentiometric titrations, redox and precipitation titrations.

Application of Electrochemistry: Electrode reaction fundamentals, potentials of electrochemical reactions, Electrochemical cells and practical considerations, solvent/electrolyte for electrochemistry, working, reference and auxiliary electrodes, Applications: Potential sweep methods, linear sweep voltametry (LSV), cyclic voltametry (CV), Practical considerations for potential sweep methods, Example of application of CV to study Rh complexes, surface- attached analytes in CV

Fuel analysis: Classification of fuels, grading of coal, proximate and ultimate analysis of coal, producer, water and natural gas, calorific value of fuel, Flash and fire point of liquid fuels, aniline point of liquid fuels, carbon residue of liquid fuels, octane and cetane numbers

Clinical Chemistry and Drug Analysis
Clinical Chemistry: Composition of blood-collection and preservation of samples, clinical analysis, serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin,

globulins, barbiturates, acid and alkaline phosphates. Immunoassay : principles of radio immunoassay (RIA) and applications, blood gas analysis.
Drug analysis : Narcotics and dangerous drug, Classification of drugs, screening by gas chromatography and thin-layer chromatography and spectrophotometric measurements.

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Theory

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BOOKS RECOMMENDED

1. A Textbook of Quantitative Inorganic Analysis, A. I. Vogal, Longman
2. Analytical Chemistry, G. D. Christian, J. Wicy.
3. Fundamentals of analytical Chemistry, D. A. Skoog. D. M. West and F. J. Hooler, W. B. Saunders.
4. Analytical Chemistry-Principles. J. H. Kennedy and W. B. Saunders
5. Analytical Chemistry-Principles.and Techniques. L. G. Hargis, Prentice Hall.
6. Analytical Chemistry, 2nd Edn., Kellner, Mermet, Otto, Valcarcel, Widmer. Wiley-VCH
7. Applications of physical methods to Inorganic and Bioinorganic Chemistry, Robert A. Scott, Charles M. Lukehart, Wiley.
8. Principles and practice of Analytical Chemistry, 5th Edn., Fifield & Kealey, Bleckwell Science.
9. Basic concepts of Analytical Chemistry, 2nd Edn., S. M. Khopkar, New Age Intl. Ltd. Publishers.
10. Analytical Chemistry, H. Kaur, Pragati Prakashan.
11. Analytical Chemistry, Dr. Alka Gupta, Pragati Prakashan.
12. Analytical Chemistry, Krupadanam et al, Universities Press.
13. Analytical Chemistry, Kealey and Haines, Instant Notes, Viva.

DETAILED SYLLABUS

Course No.: **PSCHTE402** Course Category: **PSEC**
Title: **Organotransition Metal Chemisty**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**
Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Compounds of Transition Metal-Carbon Multiple Bonds
Alkylidenes, alkylidynes: low valent (Fischer) and high valent (Schrock) carbenes and carbynes-synthesis, nature of bond, structural characteristics, nucleophilic and electrophilic reactions of the ligands and applications.

Transition Metal – π Complexes
Transition Metal ï ´ complexes with unsaturated organic molecules like alkenes, alkynes, allyls, diene and arene complexes, preparation, properties, chemical reactions, nature of bonding and structural properties.

σ – Bonded Transition Metal Complexes (Hydrocarbyls)
Types, bonding and structure of hydrocarbyls, routes of synthesis, thermal stability and decomposition pathways, chemical reactions and applications of organo-copper compounds in organic synthesis.

Homogeneous Catalysis
Stoichiometric reactions for catalysis, activation of C-H bond, homogeneous hydrogenation catalysis (Wilkinsons Catalyst), Asymmatric Hydrogenation using Chiral Catalyst, Zeigler-Natta polymerization of olefins, catalytic reactions involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction), Methanol carbonylation and olefin oxidation: Wacker, Monsanto & Cativa process.

Fluxional Organometallic Compounds
Fluxionality and dynamic equilibria in compounds such as ɖ^2-olefin, ɖ^3-allyl and dienyl complexes, non-rigid molecules in different coordination geometry.

Transition Metal Compounds with Bonds to Hydrogen
Chemistry of transition metal compounds with bonds to hydrogen: Types, synthesis and chemical reactions; Aluminohydrides and Borohydrides.

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BOOKS RECOMMENDED

1. Principles and Applications of Organotransitiion Metal Chemistry, J.P. Collman, L.S. Hegsdus, J.R. Norton and R.G. Finke, University Science Books.
2. The Organometallic Chemistry of the Transition Metals, R.H. Crabtree, John Wiley.
3. Metallo-organic Chemistry, A.J. Pearson, Wiley.
4. Organometallic Chemistry, R.C. Mehrotra and A. Singh, New Age International.
5. Basic Organometallic Chemistry, Concepts, Syntheses and Applications, B.D. Gupta and A.J. Elias, University Press.

DETAILED SYLLABUS

Course No.: **PSCHTE403** Course Category: **PSEC**

Title: **Bioinorganic and Supramolecular Chemistry**

Credits: **04** Maximum Marks: **100**

No.of hours**: 60**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Bioenergetics and ATP Cycle

DNA polymerization, glucose storage, metal complexes in transmission of energy, chlorophyllôs, photosystem I and photosystem II in cleavage of water.

Transport and storage of dooxygen

Heme proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, hemocyanins and hemerythrin, model synthetic complexes of iron, cobalt and copper.

Nitrogen fixation

Biological nitrogen fixation and its mechanism, nitrogenase, chemical nitrogen fixation.

Electron transfer in biology

Structure and function of metalloproteins in electron transport processes ï Cytochromes and Iron-Sulphur proteins, synthetic models.

Metal Storage, Transport and Biomineralization

Ferritin, transferrin and siderophores.

Zinc enzymes ï carboxypeptidase and carbonic anhydrase

Iron enzymes ï catalase, peroxidase and cytochrome P-450

Copper enzymes ï superoxide dismutase

Molybdenum oxotransferase enzymes ï Xanthine oxidase, coenzyme Vitamin B_{12}.

Supramolecular Chemistry

Molecular recognition

Introduction to recognition, information and complementarity, Molecular receptors- design Principles, Spherical recognition- cryptates of metal cations, Tetrahedral recognition by Macrocyclic cryptands, Recognition of ammonium ions and related substrates, Recognition of neutral molecules, Recognition of anionic substrates (anionic coordination).

Transport processes and carrier design

Carrier ï mediated transport, Cation transport processes ï Cation Carriers, Anion transport Processes ï anion carriers, Coupled processes.

Molecular and Supramolecular devices, supramolecular photochemistry, supramolecular electronic devices, supramolecular ionic devices

Metals in medicine

Metal deficiencies and diseases, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs.

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BOOKS RECOMMENDED

1. Principles of Bioinorganic Chemistry, S.J. Lippard and J.M. Berg, University Science Books.
2. Bioinorganic Chemistry, I. Bertini, H.B. Gray, S.J. Lippard and J.S. Valentine, University Science Books.
3. Inorganic Biochemistry Vols. I and II ed., G.L. Eichhorn, Elsevier.
4. Progress in Inorganic Chemistry, Vols. 18 and 38 ed., J.J. Lippard, Willey.
5. Supramolecular Chemistry, J. M. Lehn, VCH.

DETAILED SYLLABUS

Course No.: **PSCHTE404** Course Category: **PSEC**
Title: **Solid State Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Preparative Methods and Crystal Symmetry
General Principles of Solid State Reactions, Preparation of materials in solid state: Precursor, ceramic, sol-gel, hydrothermal, electrochemical reduction methods, vapour phase transport and high pressure methods, preparation of thin films, growth of single crystals, Closed packed structures: cubic close packing and hexagonal close packing, Some important structure types : NaCl, ZnS, CsCl and perovskite ($SrTiO_3$).

Crystal Defects and Solid Solutions
Crystal defects - Perfect and imperfect crystals, Intrinsic and extrinsic defects, Point defects (Schottky and Frenkel defects), Thermodynamics of Schottky and Frenkel defect formation, Colour centres, Line defects: Edge dislocation and Screw dislocation, Plane defects: Grain boundary and Staking faults, Topochemical control of solid state organic reactions, New superconductors
Solid solutions: Substitutional solid solutions, interstitial solid solutions, more complex solid solutions mechanisms, requirements for solid solutions and formation.

Structure of Solids
Crystal systems, Bravais lattice, lattice planes, Miller indices and directions, symmetry: point symmetry, space symmetry and point groups. Representation of point groups and selected examples, space groups.

Electronic and Ionic Conduction
Metals, insulators and semiconductors, electronic structure of solids ; chemical and physical approaches- band theory, band structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping of semiconductors, Applications of semiconductors, Controlled valency semiconductors, Band structure of inorganic solids, Ionic conductivity in solids, Solid electrolytes- Fast ion conductors: Ŭ-AgI, ɓ-Alumina, Halide ion conductors, Oxide ion conductors.

Magnetic and Dielectric Properties
Magnetic properties ï classification of materials. Behaviour of substances in a magnetic field, effect of temperature : Curie and Curie-Weiss laws, calculation of magnetic moments, Mechanisms of ferro and anti-ferromagnetic ordering, super exchange and double exchange, Ferromagnetic domains and hysteresis, soft and hard magnetic materials, Dielectric materials, Ferroelectricity, Pyroelectricity, Piezoelectricity, Applications of Ferro-, Piezo- and Pyroelectrics.

PATTERN OF EXAMINATION

Theory
There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test shall have marks weightage of 60% and its duration will be of 03 hours. **Minor**ï **I** will be held

after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minorï II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.
The major test will be held at the end of semester on completion of 41% to 100% of the syllabus. This test will have seven questions (each of twelve marks). The students have to attempt five questions in all. Question no. 1 (short answer type) will be compulsory and will be set out from 40% of syllabus covered in Minor I & II. The remaining six questions will be from across the syllabus of 41% to 100% i.e. beyond Minor I & II. The student has to attempt any four questions out of six questions.

NOTE: *Candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will not be allowed to take Major Test. Such candidates shall re-appear in the Minor Test/s only once in which he/she has failed to be conducted alteast fifteen days before the Major Test.*

BOOKS RECOMMENDED

1. New Directions in Solid State Chemistry: C.N.R. Rao and J. Gopalakrishan, Cambridge University press, Cambridge.
2. Solid State Chemistry, A.R. West, John Wiley, New York.
3. Solid State Physics, N.J. Dekker, Macmillan, London.
3. Solid State reactions, H. Schmalaried, A.P., London.
4. Magnetochemistry, R.L. Catin, Springerverlag, Berlin.
5. Solid State Chemistry, N.B. Hannay, Prentice Hall (India) Ltd., New Delhi.
6. Solid State Chemistry, H.V. Keer.
7. Solid State Chemistry, An Introduction, L. Smart and E. Moore, Nelson Thrones Ltd, U.K.

DETAILED SYLLABUS

Course No.: **PSCHTE405** Course Category: **PSEC**
Title: **Polymer Chemistry**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Introduction
Importance of polymers, Basic concepts: Monomers, repeat units, degree of polymerization. Linear branched and network polymers, classification of polymers. Polymerization: Condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer reactions. Polymerization in mohomegeous and heterogeneous systems.

Polymer Characterization
Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, ismotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance.

Structure and Properties
Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structures of polymers. Crystallization and melting. Polymer structure and physical properties-crystalline melting point, T_m-melting points of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, T_g, effect of molecular weight, diluents, chemical structure, chain topology, branching and cross lonking.

Polymer Processing
Property requirements and polymer utilization, Plastics, elastomers and fibres. Processing techniques: Compounding, Calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning.

Properties of Commercial Polymers
Polyethylene, polyvinyl chloride, polyamides, polysters, phenolic resins, epoxy resins and silicon polymers. Functional polymers-Fire retarding polymers and electrically conducting polymers, biomedical polymers-contact lens, dental polymers artificial heart, kidney, skin and blood cells.

PATTERN OF EXAMINATION

Theory
There shall be two **Minor (I & II)** and one **Major** tests in each theory course. Each Minor test shall have marks weightage of 20% and its duration will be of 1½ hour. The Major test shall have marks weightage of 60% and its duration will be of 03 hours. **Minor**ï **I** will be held

after 3-4 weeks on completion of 20% of the prescribed syllabus. **Minorï II** will be held after 8-9 weeks on completion of 21% to 40% of the prescribed syllabus.

The major test will be held at the end of semester on completion of 41% to 100% of the syllabus. This test will have seven questions (each of twelve marks). The students have to attempt five questions in all. Question no. 1 (short answer type) will be compulsory and will be set out from 40% of syllabus covered in Minor I & II. The remaining six questions will be from across the syllabus of 41% to 100% i.e. beyond Minor I & II. The student has to attempt any four questions out of six questions.

NOTE: *Candidates who have appeared in Minor Tests and failed to get the minimum required marks i.e. 14 out of 40 will not be allowed to take Major Test. Such candidates shall re-appear in the Minor Test/s only once in which he/she has failed to be conducted alteast fifteen days before the Major Test.*

BOOKS RECOMMENDED

1. Textbook of Polymer Science, F.W. Billmeyer Jr. Wiley.
2. Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar, Wiley-Eastern.
3. Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R.M. Ottanbrite.
4. Contemporary Polymer Chemistry, H.R. Alcock and F.R. Lambe, Prentice Hall.
5. Physics and Chemistry of Polymers, J.M.G. Cowie, Blackie Academic and Professional.

DETAILED SYLLABUS

Course No.: **PSCHTE406** Course Category: **PSEC**
Title: **Chemistry of Materials**
Credits: **04**
No.of hours**: 60** Maximum Marks: **100**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Multipurpose Materials
Ferrous alloys; Fe-C phase transformations in ferrous alloys, stainless steels; non-ferrous alloys, properties of ferrous and non-ferrous alloys and their applications.

Glasses, ceramics and Composites
Glassy state, glass formers and glass modifiers, applications Ceramic structures, mechanical properties.
Microscopic composites; dispersion-strengthened and particle-reinforced fibre-reinforced composites, macroscopic composites.

Thin Films and Langmuir-Blodgett Films
Langmuir-Blodgett (LB) film, growth techniques, photolithography, properties and applications of thin and LB films.

Liquid Crystals
Mesomorphic behavior, classification of liquid crystals, nematic and smectic mesophases; homeotropic, planer, schlieren textures, Nematic droplets, Mauguin textures, Texturesin smectic phases, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic C phases, optical properties of liquid crystals. Dielectric properties.

Applications and Processing of Ceramics
Types and applications of Ceramics
Glasses and glass ceramics, clay products, refractories, abrasives, cements, advanced ceramics; Piezoelectric ceramics, microelectrochemical systems, optical fibers, ceramic ball bearings.
Fabrication and processing of Ceramics
Fabrication and processing of glasses; glass properties, glass forming, heat treatment glasses. Fabrication and processing of clay products, powder processing, tape casting.

High T_C Materials
Defect perovskites, high T_C superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high T_C materials, applications of high T_C materials.

Organic Solids, Fullerences, Molecular Devices
Conducting organics, organic superconductors, magnetism in organic materials.
Fullerences-doped, fullerences as superconductors.

Composites

Particle-reinforced composites; large particle composites, dispersion strengthened composites, Fiber-reinforced composites; influence of fiber length, influence of fiber orientation and concentration, fibre phase, matrix phase, polymermatrix composites, carbon-carbon composites, hybrid composites, processing of fiber-reinforced composites, structural composites; laminar composites, sandwich panels.

PATTERN OF EXAMINATION

Theory

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BOOKS RECOMMENDED

1. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders Collage.
2. Materials Science and engineering, An Introduction, W.D. Callister, Wiley.
3. Principles of the Solid state, H.V. Keer, Wiley Eastern.
4. Materials Science, J.C. Anderson, K.D. Leaver, J.M. Alexander and R.D. Rawlings, ELBS.
5. Thermotropic Liquid Crystals, Ed., G.W. Gray, John Wiley.
6. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.

DETAILED SYLLABUS

Course No.: **PSCHTE407** Course Category: **PSEC**
Title: **Heterocyclic Chemistry and Asymmetic Synthesis**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Nomenclature of Heterocycles
Replacement and systematic nomenclature (Hantzsch-Widmann system) for monocyclic, fused and bridged heterocycles and simple spiroheterocycles. Carbocycles, ring assemblies, same repeating units, different repeating units.

Aromatic Heterocycles
General chemical behavior of aromatic heterocycles, classification (structural type), criteria of aromaticity (bond lengths, ring current and chemical shifts in ^{1}H NMR-spectra, empirical resonance energy, delocalization energy and diamagnetic susceptibility), Alprazolam, Aphox.

Benzo-Fused Five Membered Heterocycles
Synthesis and reactions including medicinal applications of benzopyrroles, benzofurans and benzothiophenes.

Six-Membered Heterocycles with One heteroatom
Synthesis and reactions of pyridinium salts and pyridines.
Synthesis and reactions of benzopyrylium salts, coumarins and chromones.

Six Membered Heterocycles with two or more Heteroatoms
Synthesis and reactions of diazines and triazines (Pyrazines, Pyridazines and 1,2,4-triazines).

Seven- and Large-Membered Heterocycles
Synthesis and reactions of azepines, oxepines and thiepines.

Asymmetric synthesis: Non-enzymatic approaches
Models of asymmetric synthesis using naturally occurring chiral compounds. Nucleophile and electrophile bearing chiral auxillary, Dielsï Alder cycloaddition and Claisenï cope rearrangements.
Asymmetric carbon ï carbon bond formation using alkylation, Michael reaction and addition to carbonyl compounds. Cramôs rule and Felkinï Ahn model. Asymmetric oxidation and reduction.

Asymmetric Synthesis: Enzymatic approach
Use of different types of enzymes- lipases (PLAP), oxidases, reductases, Bayer-Villiger monooxygenase, penicillin acylase and Baker yeast in organic synthesis. Enzyme-triggered cyclization of haloalkyl oxiranes catalyzed by epoxide hydrolases. application to biomimetic natural product ((3*R*,9*R*,10*R*)-panaxytriol, (-)-pestalotin and (2*R*,5*S*)-pityole) synthesis.

PATTERN OF EXAMINATION
Theory

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BOOKS RECOMMENDED

1. Heterocyclic Chemistry, Thomas L. Gilchrist, 3rd Edition, Addison Wesley Longman Limited 1997.
2. Heterocyclic Chemistry, Vol. 1-3, R.R. Gupta, M. Kumar and V. Gupta, Springer Verlag.
3. The Chemistry of Heterocycles, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Pandler, Wiley Interscience.
5. An Introduction to Heterocyclic Compounds, R.M. Acheson, John Wiley and Sons.
6. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, Eds. Pergamon Press.
7. G.Solladie, J.D. Morrison (ed.), Asymmetric Synthesis, Academic Press.
8. Advanced Asymmetric Synthesis, ed. G.R. Stephenson, Blackie, Glasgow, 1996.
9. Organic Synthesis, Michael B. Smith, McGraw Hill, International Edition.

DETAILED SYLLABUS

Course No.: **PSCHTE408** Course Category: **PSEC**
Title: **Organic Synthesis**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Disconnection Approach
An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections (1,2 and 1,3-difunctionalised compounds), chemoselectivity, reversal of polarity.

One Group C-C Disconnections
Alcohols and carbonyl compounds, regioselectivity, use of acetylenes and aliphatic nitro compounds in organic cynthesis.

Two Group C-C Disconnections
Biological, Cope and Claisen reaction, Diels-Alder reaction, 1,3-difunctionalised compounds, Ŭ, ɓ-unsaturated carbonyl compounds, 1,5-difunctionalised compounds, Michael addition and Robinson annelation.

Protecting Groups
Principle of protection of alcohol (Acetal, Acetyl and silyl ethers) and carbonyl groups.

Retrosynthesis and synthesis of following compounds:
Reserpine (Woodward synthesis), Longifolene (Corey synthesis), Hirsutene [Paquette (1990) and Oppolzer (1994) synthesis].

Organometallic Compounds of Transition Elements
Hydrogenation, hydrosilylation and hydrogen-transfer isomerization catalyzed by Ni, Pd and Rh complexes; Coupling reactions (C-C, C-N and C-O bond formation) catalyzed by Pd, Ni and Cu complexes; Carbonylation (Hydroxymethylation, hydroformylation and hydrocarboxylation of alkenes) catalyzed by Fe, Co, Pd and Ni compounds.

Oxidations
Oxidation of alcohols (Chromic acid, $KMnO_4$, $Pb(OAc)_4$, Oppenauer, Swern); aldehydes and ketones (chromium trioxide complexes); Amine (H_2O_2, peracids and quinones); sulfides (peracid, HIO_4). Oxidation of alcohols by O_2 catalysed by Pd and Co.
Oxidation with osmium and ruthenium tetraoxide, iodobenzene diacetate and thalium (III) nitrate.

Reduction
Birch reduction; Reduction of aldehydes, ketones, acids and their derivatives (Clemenson, Wolff Kishner, lithium aliminium hydride, sodium borohydride, DIBAL-H, diborane, aluminium isopropoxide).
Reduction of nitro, azo, oxime and nitrile groups (Lithium aliminium hydride and DIBAL-H).

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BOOKS RECOMMENDED

1. Designing Organic Synthesis, S. Warren, Wiley.
2. Organic Synthesis ï Concept, Methods and Starting Materials, J. Fuhrhop and G. Penzillin, Verlage VCH.
3. Some Modern Methods of Organic Synthesis, W. Carruther, Cambridge University Press.
4. Principles of Organic Synthesis, R. Norman and J.M. Coxon, Blackie Academic & Professional.
5. Chemistry of Natural Products, S.V. Bhat, B.A. Nagasampagi and M. Sivakumar, Narosa Publ. House, N.D.
6. Progress in Total Synthesis Vol. 1, E. Danishetsky and S. Danishetsky, Appleton Centyrt Crafts, N.Y.
7. Organic Synthesis, J. Fuhrhop and G. Penzlin, (1986). VCH, Verlags, Weinheim, Germ.
8. The Total Synthesis of Natural Products Vol. 4, J. Apsimon (1981), John Wiley Interscience Publ. (N.Y.).
9. The Logic of Chemical Synthesis, E.J. Corey and X.M. Cheng, John Wiley and Sons, New York, N.Y.
10. Organic Chemistry, Maitland Jones Jr., W.W. Norton and Co. Inc.
11. Organometallic Chemistry: A unified approach, New Age International Publishers.
12. Applications of Transition Metal Catalysis in Organic Synthesis, Brandsna, Vasilvsky, Verkruijsse, Springer, Berlin.
13. The Art and Science of Total Synthesis, K.C. Nicolaon, D. Vourloumis, N. Windsinger & P.S. Baran , Angew Chem. Int. Ed. 2000, Vol. 39, pp 44-122.

DETAILED SYLLABUS

Course No.: **PSCHTE409** Course Category: **PSEC**
Title: **Chemistry of Natural Products and Molecular Rearrangements**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Terpenoids and Carotenoids
Classification, occurrence and isoprene rule. Structure determination, stereochemistry and synthesis of the following representative molecules:
Ǔ Terpineol, Menthol, Farnesol, Santonin, ɓï Carotene and squalene.

Alkaloids
Definition, physiological action, occurrence and isolation. Structure elucidation and synthesis of Quinine, Morphine and Atropine.

Steroids
Occurrence, basic skeleton, Dielôs hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Testosterone, Estrone, Progestrone.

Plant Pigments
Occurrence, and general methods of structure determination of anthocyanins, flavones & isoflavones. Synthesis of Apigenin, Quercetin, Cyanidin and Cyanin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway.

Rearrangements
General mechanistic considerations ï nature of migration, migratory aptitude, memory effects.
A detailed study of the following rearrangements:
Tiffeneau- Demjanov, Benzil-Benzilic acid, Favorskii, Stevens, Arndt-Eistert synthesis, Neber, Hofman, Curtius, Schmidt, Baeyer-Villiger and Shapiro, Eschenmosher and Prins reaction.

PATTERN OF EXAMINATION

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BOOKS RECOMMENDED

1. Natural Products: Chemistry and Biological Significance, J.Mann, R.S. Davidson, J.B.Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
2. Organic Chemistry, Vol.2, I.L. Finar, ELBS.
3. Stereoselective Synthesis: A practical Approach, M.Nogradi, VCH.
4. Roddôs Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier.
5. Chemistry, Biological and Pharmacological Properties of Medicinal Plants from the Americas, Ed. Kurt Hostettmann, M.P. Gupta and A.Marston, Harwood Academic Publishers.
6. Introduction to Flavonoids, B.A. Bohm, Harwood Acadeï mic Publishers.
7. New Trends in Natural Product Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publishers.
8. Polar rearrangements, Laurence M. Harwood, Oxford Science Publications, Oxford University Press.
9. Organic Synthesis, Michael B. Smith, McGraw Hill.

DETAILED SYLLABUS

Course No.: **PSCHTO410** Course Category: **PSOCC**
Title: **Chemistry in Daily life**
Credits: **04** Maximum Marks: **100**
No.of hours**: 60**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Water and its treatment

Water and water formation, importance of water, water requirements (Domestic, Industrial, Institutional, Public and Agriculture). Water quality standards: Desirable limits, Permissible limits, PPM and PPB. Drinking water physical parameters: Color, Taste-odor, Turbidity, Suspended solids and temperature. Hard and soft water. Hardness of water. Disadvantages of hard water. Mineral and distilled water. Water softening by lime-soda, zeolite, Ion-Exchange method and demineralization processes (Reverse Osmosis). Defects like scale and sludge formation, caustic embrittlement, corrosion, priming and foaming caused in boilers by impure water and their remedies.

Waste water characteristics, Waste water treatment, Flowchart of waste water treatment plant: Sedimentation, Coagulation Flocculation, Settling tanks, Disinfection (Chlorination, UV, Ozonization).

Green Chemistry

Introduction and basic principles, Designing of a green chemical syntheses. Green solvents and catalysts in organic synthesis, The revolution in biology in relation to green chemistry, Feedstocks: Maximum utilization of renewable and biological materials, green chemistry in sustainable development.

Fuel Chemistry

Classification of fuels and their calorific value.

(a) **Coal**: Composition, carbonization. Coal gas, producer gas and water gas. Uses of coal tar based chemicals. Coal gasification (Hydro Gasification and Catalytic gasification).

(b) **Petroleum:** Composition of crude petroleum, Refining and different types of petroleum products and their applications. Fractional Distillation (Principle and process), Cracking (Thermal and catalytic cracking), Reforming Petroleum and non-petroleum fuels (LPG, CNG, LNG, bio-gas, fuels derived from biomass). Advantages of gaseous fuel over solid and liquid fuel. Classification of three stages of fuel used in cryogenic engines

Polymer:

Classification. Preparation, structure, properties and applications of the polymers, (Polyolefins, Polystyrene) and styrene copolymers, Poly (vinyl chloride), Poly (vinyl acetate), Acrylic polymers, Fluoro Polymers, Polyamides. Phenol formaldehyde Resins (Bakelite, Novalac), Polyurethanes, Silicone Polymers, Conducting Polymers, Biomedical polymers: implants, contact lens and dental polymers.

Drugs and Agrochemicals

(a) Drugs: Drugs classes and side effects: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (sulphonamides; sulphanethoxazol, sulphacetamide, trimethoprim); antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone).

(b) Agrochemicals: Definition, importance and general classification of agrochemicals. Classification of pesticides on chemical nature and according to target species and mode of action. Physical and chemical properties, degradation, mode of action, uses and toxicity of **Organophosphorus** like Acephate, Dimethoate, Chlorpyiphos, Temephos, Quinolphos, methyl parathion; **Organochlorines** like Endosulfan and **Carbamate** like Cartap hydrochloride.

PATTERN OF EXAMINATION

Theory

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BOOKS RECOMMENDED

1. B.S.N. Raju, *Water Supply and Wastewater Engineering*, Tata Mcgraw Hill Publishing Co Ltd, **2001**
2. Kent James A. (ed.), Reigelôs Handbook of Industrial Chemistry, Kluwer Academic/Plenum Publishers, 10th edition, New York.
3. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
4. Seymour/Carraher's Polymer Chemistry: Sixth Edition, Revised and Expanded, Charles E Carraher, Jr. Marcel Dekker, inc. New York.
5. R. Gopalan, D. Venkappayya, S. Nagarajan: Engineering Chemistry, Vikas Publications, New Delhi.
6. Shreve R.N. Brink. J.A., Chemical Process Industries, International student edition, Pubs: McGraw Hill Book Co. New York, 1960.
7. Melnikov N.N., Chemistry of Pesticides, Pubs: Springer-Verlag, New York, 1971.
8. Hakishan, V.K. Kapoor: Medicinal and Pharmaceutical Chemistry, Vallabh Prakashan, Pitampura, New Delhi.
9. Agricultural insect pests of the topics and their control-D.S.Hill, Cambridge Univ. Press, 1983.
10. Chemistry of Insecticides and Fungicides: U.S. Shree Ramulu Oxford & IBH Pub., 2nd, 1995.

DETAILED SYLLABUS

Course No.: **PSCHLE411** Course Category: **PSEC**
Title: **Laboratory Course: Inorganic Chemistry**
Credits: **08** Maximum Marks: **200**
No.of hours**: 120**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Preparation of selective inorganic compounds and their study by IR, Electronic spectra, ^1H NMR, TGA and magnetic susceptibility measurement. Handling of air and moisture sensitive compounds involving vacuum lines.

Selection can be made from the following:

1. Preparation of tetraamminecarbonatocobalt(III) nitrate and its conversion to pentaamminecholorocobalt(III) chloride; Inorganic Syntheses; Wiley-Interscience: pp 103 (1983).
2. Preparation of trans-dicholoro bis(ethylenediamine)cobalt(III) chloride and its conversion to cis-isomer; Inorg. Synth. 14, 63 (1973,).
3. Preparation of tris(ethylenediamine)nickel(II) chloride and its conversion to bis(ethylenediamine)nickel(II) chloride; Inorg. Synth. 6, 200, (1960); Inorg. Synth. 6, 198, (1960).
4. Preparation of pentaamminecholorocobalt(III) chloride and study of Linkage isomers by its conversion to pentaamminenitritocobalt(III) chloride and to nitro isomer followed by IR characterization; Inorganic Chemistry 18, 1869 (1979).
5. Preparation and mangnetic moment of $Cu(acac)_2H_2O$; Inorg. Synth. 20: 53 (1980).
6. Separation of optical isomer cis-$[Co(en)_2Cl_2]Cl$. J. Chem. Soc., 1960, 4369.
7. Ion exchange separation of oxidation state of vanadium. J. Chem. Educ., 1980, 57, 316; 1978, 55, 55.
8. Preparation of Fe(II)chloride (use it as Friedelcraft chlorination source). J. Org. Chem., 1978, 43, 2423, J. Chem. Edu., 1984, 61, 645; 1986, 63, 361.
9. Preparation and use of Ferrocene, J. Chem. Edu., 1966, 43, 73; 1976, 53, 730.
10. Preparation of phosphine Ph_3P and its transition metal complexes. Inorg. Synth. 15, 45 (1974).
11. Reaction of Cr(III) with a multidentate ligand: a kinetic experiment (visible spectra Cr-EDTA complex) J.A. C. S., 1953, 75, 5670.
12. Preparation of metal-pyridine complexes, $M(C_5H_5N)_y(NCS)_2$, (M = Mn, Fe, Co or Ni; y = 4, for M= Cu or Zn; y = 2), J. Chem. Edu, 50, 70 (1973).
13. Preparation of Chromium(III) complexes, $[Cr(H_2O)_6]NO_3.3H_2O.[Cr(H_2O)]_4Cl_2]Cl.2H_2O$, $[Cr(en)_3]Cl_3.Cr(acac)_3$, Inorg. Synth.,13, 184 (1972).
14. Controlled synthesis of two copper oxalatehydrate complexes, $K_2[Cu(C_2O_4)_2]\cdot 4H_2O$ and $K_2[Cu(C_2O_4)_2]\cdot 2H_2O$: Kinetic vs thermodynamic factors. *J. Chem. Educ.*, 2009, 86 (5), p 598.
15. Preparation and check the purity of isomer of *cis*- and *trans*-potassium diaquadioxalatochromate(III) complexes, $K[Cr(C_2O_4)_2(H_2O)_2].2H_2O$. *Nature, Volume 169, Issue 4313, pp. 1103 (1952).*
16. Prepare ammine complexes of Ni(II) and carry out its ligand exchange reactions with bidentate ligands like acetylacetone(acac), dimethylglyoxime (DMG), glycine (gly) by substitution method (one pot synthesis).

Gravimatric and Volumetric analysis: Barium, Copper, Cobalt, Iron, Vanadium, Nickel, Manganese, Aluminium, Chromium, Zinc, Sulfur, Chloride (Volhardôs method) etc.

Separation by Paper/TLC/Column Chromatography:

1. Separation of Permanganate and Bichromate ions on Alumina column and their Estimation from Beer Law plots.
2. Determination of lonisable chloride in a Complex by cation exchange column (separation followed by Mohr's titration of elute for estimation).
3. Separation of Cobalt(II) and Nickel(II) on anion exchange column followed by estimation through EDTA titrations.
4. Separation of two Cobalt (III) complexes *viz* $[Co(NH_3)_6]Cl_3$ and $[Co(NH_3)_5Cl]Cl_2$ on Silica column.
5. Ion exchange separation of Hydration/ionization isomers of Chromium(III) Chloride ($CrCl_3$).
6. Determination of Rf value of cations of transition metal ions by paper and thin layer chromatography

PATTERN OF EXAMINATION

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Vogel's textbook of quantitative chemical analysis (5^{th} and 6^{th} edition).
2. G. R. Chatwal, Instrumental Methods for Chemical Analysis, 5^{th} ed., Himalaya Publications (India).

DETAILED SYLLABUS

Course No.: **PSCHLE412** Course Category: **PSEC**
Title: **Laboratory Course: Physical Chemistry**
Credits: **08** Maximum Marks: **200**
No.of hours**: 120**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

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1. Determination of Planckôs Constant by means of LEDôs method based on expression of diode current for $V<V_0$. The dependence of current with temperature is to be measured, keeping the V slightly below V_0 and material constant ɖ to be obtained from V-I characteristics of the diode.
2. Four Probe set-up for measuring the resistivity of very low to highly resistive samples at temperature upto 200°C with PID controlled oven, having the following setup:
   (i) Four Probe Arrangement with built-in RTD sensor & PID controlled Oven
   (ii) D.C. Microvoltmeter
   (iii) Constant Current Source
   For low resistivity samples like thin films for metals and alloys
   (iv) Low Current Source
3. Measurement of Magentoresistance of Semiconductors with the apparatus consisting of:
   a) Four Probe Arrangement
   b) Sample: Ge Crystal (n-type)
   c) Magnetoresistance setup
   d) Electromagnet
   e) Constant Current Power Supply
   f) Digital Gaussmeter
4. Study of Dependence of Hall Coefficient on Temperature by the following setup:
   a) Hall Effect Setup
   b) Hall Probe (Ge: p-type) with a small oven
   c) Electromagnet
   d) Constant Current Power Supply
   e) Digital Gaussmeter
5. Study of the energy band-gap and diffusion potential of P-N Junctions.
6. Study of T_C and other related properties in high T_C superconductors.
7. Determine the order, the velocity constant and the activation energy of the hydrolysis of tertiary-amyl iodide.
8. Determine the velocity constant of the decomposition of benzene diazonium chloride.
9. Determine the velocity coefficient of inversion of sucrose by 0.5N hydrochloric acid at 25°C.
10. To determine the basicity of an organic acid by conductometric measurement.
11. To study the kinetics of the reaction between potassium persulphate and potassium iodide.
    a) Determine the rate constant and order of the reaction.
    b) Study the influence of ionic strength on the rate constant.
12. Determine the dissociation constant of picric acid by studying its distribution between benzene and water.
13. Investigate the reaction between acetone and iodine, potassium permanganate and oxalic acid.
14. Precipitation titrations using conductivity meter.

15. Determine acid and base dissociation constant of amino acid and find isoelectric point of acid (glycine).

PATTERN OF EXAMINATION

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Practical Physical Chemistry, A.M. James and F.E. Prichard, Longman.
2. Findleyôs Practical Physical Chemistry, B.P. Levitt, Longman.
3. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
4. Experiments in Physical Chemistry by Shoemaker.
5. Practical Physical Chemistry by Viswanathan and Raghavan.

DETAILED SYLLABUS

Course No.: **PSCHLE413** Course Category: **PSEC**
Title: **Laboratory Course: Organic Chemistry**
Credits: **08** Maximum Marks: **200**
No.of hours**: 120**

Syllabus for the examinations to be held in May 2020, May 2021 & May 2022.

Multi-Step Synthesis of Organic Compounds
The exercise should illustrate the use of organic reagents and may involve purification of the products by chromatographic techniques.

Photochemical reaction: BenzophenoneŸ BenzpinacolŸ Benzpinacolone

Beckmann rearrangement: Benzanilide from benzene
BenzophenoneŸ Benzophenone oximeŸ Benzanilide

Benzilic acid rearrangement: Benzilic acid from benzoin
BenzoinŸ BenzilŸ Benzilic acid
Synthesis of heterocyclic compounds-Three component coupling for the synthesis of dihydropyrimidinones.

Scraup Synthesis: Preparation of quinoline from aniline

Fisher – Indole synthesis: Preparation of 2-phenylindole from phenylhydrazine

Synthesis using microwaves
Alkylation of diethyl malonate with benzyl chloride
Synthesis using phase transfer catalyst
Alkylation of diethyl malonate or ethyl acetoacetate with an alkyl halide

Extraction of Organic Compounds from Natural Sources

1. Isolation of caffeine from tea leaves
2. Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)
3. Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported)
4. Isolation of piperine from black pepper
5. Isolation of lycopene from tomatoes

Spectrophotometric (UV/VIS) estimations of any four of the following:

1. Amino acids
2. Proteins
3. Carbohydrates
4. Cholesterol
5. Ascorbic acid
6. Aspirin
7. Caffeine

PATTERN OF EXAMINATION

Practical

The daily evaluation of practical records/assignments/viva-voce, etc. shall have marks weightage of 50%. The final practical performance test along with viva-voce examination will be held at the end of semester covering 100% of the syllabus and having marks weighage of 50%.

BOOKS RECOMMENDED

1. Elementary Practical Organic Chemistry, Part-1, 2nd ed., Vogel.
2. Monograph on Green Chemistry by Green Chemistry Task Force Committee, DST.
3. Spectrophotometric determination of amino acid by Michail A. Alterman, Peter Hunziker, Vol. 828, Print ISBN: 978-1-61779-444-5.